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An approach to evaluate soils influence on floristic composition of natural grasslands

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An approach to evaluate soils influence on floristic composition of natural grasslands

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Abstract

This trial aims to evaluate floristic composition of most abundant species in three soil typical of Pampa biome on Brazil. The survey was held at Maronna Foundation located on southern Alegrete municipality, on Rio Grande do Sul, Brazil's state. Regional climate belongs to Koeppen's Cfa class. Soil types were shallow basalt (Psamments e Orthents), deep basalt (Vertisols) and sandy soil (Acrisols or Ultisols). Floristic composition were evaluated by visual ranking of aerial biomass of the major species (transformed to kg of dry matter per hectare), calibrated by cuts at ground level, according to field procedures of BOTANAL method. Grasses were clustered according to functional groups based on its leaf traits as proposed by Cruz et al. (2010). This approach proposed a ranking of grasses that ranges from its increasing leaf dry matter, and decreasing specific leaf area, from A to C groups. Total forage mass varied according to soil type. Contribution of A, B and C groups on total forage mass range from 40 to 60 %. *Paspalum notatum*, from B group, were found on the three soils, being more abundant on sandy and shallow basalt soils. *Andropogon lateralis*, from C group, was dominant on deep basalt soils, while *Axonopus affinis*, from A group, has higher biomass contribution on the same soil. We concluded that soil type affected floristic composition, even with this simplified diagnosis criteria.

Introduction

Pampa biome presents particular flora with great biodiversity, around 3 thousand plant species, grasses being the most abundant and diverse family with about 450 species (Boldrini, 2009). There is also a great cultural national and regional heritage linked to this biodiversity. Most of Guarani's aquifer lies below Pampa biome region (MMA, 2017). Since Iberian colonization, free-ranging livestock (cattle and sheep) on these natural grasslands had been regional main economic activity. In addition to providing important economic results it has allowed natural grasslands conservation, and also developed the culture of a unique mestizo human type of transnational relevance, the so called "gaucho" (MMA, 2017). The progressive introduction and expansion of crops and forests monocultures, mainly soybeans and eucalyptus, had greatly degraded and uncharacterized Pampa natural grasslands. Therefore, for the maintenance of livestock activity and the preservation of this biome, it is necessary to use management practices appropriate to the environment and animal production. One of the alternatives to support management is the functional approach. This work aimed to evaluate the composition of predominant grass species belonging to three main grasses functional types (Cruz et al, 2010) in three types of soils in the Pampa biome. These functional groups could reflect morphogenetic traits that enable the species to prioritize resources (nutrients, radiation, water use,...) capture or resources conservation in its leaf tissues.

Methods and Study Site:

The work was carried out at the Maronna Foundation, located at the south of the municipality of Alegrete, Rio Grande do Sul state, within the Ibirapuitã Preservation Area, on South Brazil. In Koeppen's classification, the region's climate corresponds to the mesothermal, humid subtropical type of Cfa class with an average annual rainfall of 1350 mm. The treatments were three classes of soil: superficial basalt (Regolitic Neosols, Regosols, Entisols (Psamments and Orthents), deep basalt (Ortical ebamic vertisols) and sandstone (arenic dystrophic red argisol, acrisols, ultisols). The floristic composition was evaluated by visual estimate of the aerial biomass (kg of dry matter ha⁻¹) of the species following the field procedure of BOTANAL method (TOTHILL et al., 1992), adapted to consider only the dominant species that contribute **with** more than 10% of the total forage mass in each quadrat. Sixteen quadrats of 50x50cm were evaluated in each type of soil. Four surveys were carried out: summer (February 2019), autumn (May 2019), spring (October 2019) and summer (February 2020). With the data obtained, the percentage of contribution of species representing the functional types proposed by Cruz et al (2010) was calculated: functional type A, *Axonopus affinis*; functional type B, *Paspalum notatum*, and functional type C, *Andropogon lateralis*.

According to the authors, the first two groups represent grasses with resources capture traits and the last, with resources conservation traits.

Results

Total forage mass and the mass of the evaluated species varied according to the type of soil (Table 1). The contribution of species of functional groups A, B and C in the total forage mass varied between 40 and 70% of the total forage mass for the three types of soils evaluated. *Paspalum notatum* was present in the three soils evaluated, predominantly in soils formed over sandstone and superficial basalt. *Andropogon lateralis* is the grass that predominates in deep basalt. *Axonopus affinis* showed a significant contribution only in this type of soil.

Table 1. Grasses contribution on forage mass (FM) in kg do dry matter (DM) per hectare and percentage contribution of functional groups A, B and C, as described on text, according to soil type and evaluated periods along growth season (respectively summer, autumn, spring and summer).

Grasses contribution		Andropogon lateralis		Axonopus affinis		Paspalum notatum		Total FM (kg of DM/ha)	Total % of functional groups ABC
Soil type	Dates	FM (kg of DM/ha)	% total	FM (kg of DM/ha)	% total	FM (kg of DM/ha)	% total		
Sandstone	05/02/2019	58,8	9,7	0,0	0,0	222,8	36,8	606,1	46,5
	16/05/2019	49,5	10,8	0,0	0,0	231,0	50,3	459,0	61,1
	07/11/2019	5,6	6,0	0,0	0,0	73,0	78,9	92,4	85,0
	07/02/2020	83,9	9,6	0,0	0,0	409,5	46,8	874,9	56,4
	average	49,5	9,7	0,0	0,0	234,0	46,1	508,1	55,8
Deep basalt	05/02/2019	979,2	45,0	429,6	19,8	94,1	4,3	2174,9	69,1
	16/05/2019	1363,8	45,8	561,8	18,9	32,1	1,1	2974,8	65,8
	07/11/2019	195,2	38,8	113,6	22,6	0,5	0,1	502,4	61,6
	07/02/2020	1355,1	36,2	476,7	12,7	141,6	3,8	3746,8	52,7
	average	973,3	41,4	395,4	16,8	67,1	2,9	2349,7	61,1
Superficial basalt	05/02/2019	200,0	15,2	0,4	0,0	505,0	38,3	1318,0	53,5
	16/05/2019	227,9	15,7	0,0	0,0	392,2	27,0	1453,7	42,7
	07/11/2019	24,8	8,4	0,0	0,0	141,0	48,1	293,0	56,6
	07/02/2020	3,0	0,1	1,6	0,1	669,9	28,6	2338,3	28,8
	average	113,9	8,4	0,5	0,0	427,0	31,6	1350,8	40,1

Discussion [Conclusions/Implications]

The data presented in the previous section indicate that the type of soil affects the floristic composition, evaluated through the predominant species. These results are according to several authors (Cardoso et al., 2016; Freitas et al., 2010; Ruggiero et al, 2005), that indicates a close association of soil type and vegetation physiognomy of natural vegetation in other grasslands on Brazil (“pantanal”; “campos” and “cerrado”). Considering the variation of soil type patches on the same farm, we can develop management strategies that allow increasing the efficiency of the use of forage resources according to the leaf traits of the main forage species, in this case grasses, and as already proposed by Cruz et al (2010). For example, in sandstone soils where *P. notatum* predominates, shorter grazing intervals and greater grazing intensity could be recommended, without prejudice to the dominant grass or the level of animal production. In deep basalt, where the conservative grass *A. lateralis* had the higher contribution, larger grazing intervals and lesser grazing intensity should be advocated.

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